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DESY-MAG-M-4000

Page 1 of 17

1. Scope:

This MAP describes the procedure used for winding & curing of DESY GO Coils

2. Applicable Documents:

RHIC-MAG-Q-1000	Control of Measurement Test Equipment
RHIC-MAG-Q-1004	Discrepancy Reporting Procedure
RHIC-MAG-R-7242	RHIC Hypot Testing
RHIC-MAG-R-7227	Electrical Resistance Measurement for Individual Coils
RHIC-MAG-R-7228	Magnet Coil Inductance and Q Measurement
RHIC-MAG-R-7318	Dipole /Quadrupole Inductance Testing
SMD-OPM-8.1.1.32	Operation of CBA Beam Tube Wrapper
SMD-OPM-8.1.1.36	DESY Wiring Machine
15010003	Coil Assembly

3. Requirements:

3.1 Material/Equipment

Curing Segments	25-1779.03(-01 thru -05)-4
	25-1779.04(-01 thru -05)-4
	25-1779.05(-01 thru -05)-4

Mounting Clamps

Acetone

Insulated Gloves

BNL Stock No. K-63025

PVC Gloves

BNL Stock No. K-62649

Latex Gloves

BNL Stock No. K-62854

Test Cart

ETS-001

Micrometer

3.2 Safety Precautions

- 3.2.1 The operator shall be qualified by the Cognizant Technical Supervisor in the safe operation of the DESY Wiring Machine.
- 3.2.2 The operator shall be qualified by the Cognizant Technical Supervisor in the safe operation of the Beam Tube Wrapper.
- 3.2.3 Operators shall wear safety glasses with side shields, or goggles.
- 3.2.4 Operators shall wear insulated gloves when handling heated coil assembly.
- 3.2.5 Personnel shall wear PVC gloves while handling epoxies, Latex gloves while handling acetone, ethanol, or methanol cleaning agents.
- 3.2.6 The technicians shall be qualified by their cognizant technical supervisor in the operation of the required test equipment and these electrical testing procedures. They shall be familiar with the

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DESY-MAG-M-4000

Page 2 of 17

latest revision of the applicable documents referenced in section 2. In addition, some of these tests require the technician to have special training. A list of qualified personnel shall be maintained with the Training Coordinator.

3.2.7 Some of these electrical test procedures have specific safety requirements. The technicians performing these specific tests shall rigorously follow all the safety requirements listed as well as those prescribed by the BNL ES&H standard. Operators shall wear safety glasses with side shields or goggles.

3.2.8 Caution: to avoid the possibility of static build-up during and discharge during coil winding operation, the following grounding must be installed. Attach a ground wire to the coil support tube. Attach incoming lead for coil block being wound to ground. After all the coil blocks are wound remove the ground wires.

3.3 Procedure

3.3.1 Dipole

3.3.1.1 Mount support tube into winding machine using mounting clamps and minimizing runouts. Clamp diameters may have to be shimmed to accommodate variations in tube diameters.

3.3.1.2 Note shim sizes in each clamp.

3.3.1.2.1 Position clamps as shown in Fig. 1.

3.3.1.3 Apply substrate to insulated tube.

3.3.1.3.1 Using 12" wide material, wrap substrate around wire starting 1/2" in from each clamp. Longitudinal seam should be at the 12 o'clock position.

3.3.1.3.2 Using the 2" wide material spiral wrap, substrate in between end pieces just installed. Trim to fit.

3.3.1.4 Measure and record diameter and runout measurements every 15° around circumference at 5 axial positions. Record data in computer.

3.3.1.5 Allowing a minimum of 6' coil pole leads, wind the dipole coil using the appropriate wiring file.

3.3.1.6 Splice midplane lead together at location shown by stripping back insulation and soldering together (side by side) minimum of 3" overlap. Overwrap splice with 2 layers of .001" Kapton tape.

3.3.1.7 Perform warm measurements along with Hypot and RLQ checks. Perform Hypot & RLQ in accordance with RHIC-MAG-R-7227 /7228 /7242.

Warning: The safety requirements included in the individual electrical test procedures shall be followed

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DESY-MAG-M-4000

Page 3 of 17

- 3.3.1.8 Install G-10 wedge spacers into coil. Temporarily hold in place by applying a few drops of Acetone to uncured substrate.
- 3.3.1.9 Apply blue epoxy (2850FT[12011227] + 24LV Catalyst [12011228]) to coil filling in all voids between G-10 and conductor, and between conductors. Squeegee away any excess to eliminate any high spots.
- 3.3.1.9.1 Butt wrap coil with .003" B-stage impregnated fiberglass tape. Cut tape out directly over the midplane splice. (Wrap over full width of G-10 end saddles).
- 3.3.1.10 Double overlap wrap coil with .002" Teflon.
- 3.3.1.11 Install coil into curing fixture using:
 - 25-1779.03-01-4
 - .04-01-4
 - .05-01-4curing segments. Cure @ 175⁰C for 90 minutes.
- 3.3.1.12 Remove coil from fixture and remove Teflon overwrap.
Warning: Operators shall wear insulated gloves when handling heated coil
- 3.3.1.12.1 Take diameter measurements and record (datasheet).
- 3.3.1.13 Install coil assembly into fiberglass wrapping machine.
- 3.3.1.14 Butt wrap entire coil with same material as 3.3.1.9.1.
- 3.3.1.14.1 Wrap tube with .001" Kapton with 67% overlap.
- 3.3.1.15 In same machine, wrap coil with epoxy impregnated S-glass fibre @ 27 lbs. tension, 18 turns per inch.
- 3.3.1.16 Double overlap wrap coil with .002" Teflon.
- 3.3.1.17 Install in curing fixture using same segments as in step 3.3.1.11. Cure @ 122⁰C for 90 min.
- 3.3.1.18 Remove from curing fixture and remove Teflon overwrap.
Warning: Operators shall wear insulated gloves when handling heated coil
- 3.3.1.19 Perform RLQ measurements and Impulse Test. Perform Impulse & RLQ in accordance with RHIC-MAG-R-7227 /7228 /7318
Warning: The safety requirements included in the individual electrical test procedures shall be followed

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DESY-MAG-M-4000

Page 4 of 17

3.3.2 Quad Coil

3.3.2.1 First Layer Quadrupole.

3.3.2.1.1 Mount support tube into winding machine using mounting clamps and minimizing runouts. Clamp diameters may have to be shimmed to accommodate variations in tube diameters.

3.3.2.1.2 Apply substrate to coil assembly.

3.3.2.1.2.1 Using 18" wide material, wrap substrate around the tube starting at the same point as the previous layer. Longitudinal seam should again be at one of the pole lead positions of the quadrupole to be wound.

3.3.2.1.2.2 Using the 2" wide material, spiral wrap substrate in between end pieces just installed (trim to fit).

3.3.2.1.3 Measure and record diameter and runout measurements every 15° around circumference at 5 axial positions. Record data in computer.

3.3.2.1.4 Allowing a minimum of 6' coil pole leads wind the 1st layer quadrupole using the appropriate wiring file.

3.3.2.1.5 Splice midplane leads together at location shown on drawing by stripping back insulation and soldering together (side by side) with a minimum of 3" overlap. Overwrap splices with 2 layers of .001" Kapton tape.

3.3.2.1.6 Perform Hypot and RLQ checks. Perform Hypot & RLQ in accordance with RHIC-MAG-R-7227 /7228 /7242.

Warning: The safety requirements included in the individual electrical test procedures shall be followed

3.3.2.1.7 Install G-10 wedge spacers into coil. Temporarily hold in place by applying a few drops of acetone to uncured substrate.

3.3.2.1.8 Using a 36" piece of cable, stabilize the pole leads of the dipole coil by soldering a second piece of conductor to the main conductor. The two must be soldered in the proper configuration to exit in the slots of the G-10 spacers. Only solder up to the end cap at this time.

3.3.2.1.9 Overwrap stabilized lead with 67% overlap of .001" Kapton insulation.

3.3.2.1.10 Apply blue epoxy to coil filling in all voids between G-10 and conductor, and between conductors. Squeegee away any excess to eliminate high spots.

3.3.2.1.11 Butt wrap coil within .003" B-stage epoxy impregnated fiberglass tape, cut tape out directly over the midplane splices of the quadrupole and the lead exit of the dipole coil.

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DESY-MAG-M-4000

Page 5 of 17

- 3.3.2.1.12 Double overlap wrap coil with .002" Teflon.
- 3.3.2.1.13 Install coil into curing fixture using the
 - 25-1779.03-02-4
 - .04-02-4
 - .05-02-4curing segments. Cure @ 175⁰C for 90 min.
- 3.3.2.1.14 Remove coil from fixture and remove Teflon overwrap.
Warning: Operators shall wear insulated gloves when handling heated coil
- 3.3.2.1.15 Take diameter measurements and record (data sheet)
- 3.3.2.1.16 Install coil assembly into fiberglass wrapping machine.
- 3.3.2.1.17 Butt wrap entire coil with same material as in step 3.3.2.1.11.
- 3.3.2.1.18 In same machine wrap coil with epoxy impregnated S-glass fibre @ 27 lbs. tension, 18 turns per inch.
- 3.3.2.1.19 Double overlap wrap coil with .002" Teflon.
- 3.3.2.1.20 Install coil assembly in curing fixture using the same segments as in step 3.3.2.1.13. Cure@122⁰C for 90 min.
- 3.3.2.1.21 Remove coil from curing fixture and remove Teflon overwrap.
Warning: Operators shall wear insulated gloves when handling heated coil
- 3.3.2.1.22 Take diameter measurements and record (data sheet).
- 3.3.2.1.23 Perform Warm Measurements, RLQ, and Impulse Test. Perform Impulse & RLQ in accordance with RHIC-MAG-R-7227 /7228 /7318.
Warning: The safety requirements included in the individual electrical test procedures shall be followed
- 3.3.2.2 Second Layer Quadrupole
 - 3.3.2.2.1 Mount support tube into winding machine using mounting clamps and minimizing runouts. Clamp diameters may have to be shimmed to accommodate variations in tube diameters.
 - 3.3.2.2.2 Apply substrate to coil assembly.

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DESY-MAG-M-4000

Page 6 of 17

- 3.3.2.2.2.1 Using 12" wide material, wrap substrate around the tube starting at the same axial position as the previous layers. Four longitudinal seams may be used to get around pole leads of 1st layer quad, but must be at the pole lead position.
- 3.3.2.2.2.2 Using the 2" wide material spiral wrap substrate between end pieces just installed (trim to fit).
- 3.3.2.2.3 Measure and record diameter and runout measurements every 15° around circumference at 5 axial positions. Record data in computer.
- 3.3.2.2.4 Allowing a minimum of 6' coil (pole) leads wind the 2nd layer quadrupole using the appropriate wiring file.
- 3.3.2.2.5 Remove coil from wiring machine.
- 3.3.2.2.6 Splice midplane leads together at locations shown on drawing by stripping back insulation and soldering together (side by side) with a minimum of 3" of overlap. Overwrap splices with 2 layers of .001" Kapton tape.
- 3.3.2.2.7 Perform Hypot and RLQ checks. Perform Hypot & RLQ in accordance with RHIC-MAG-R-7227 /7228 /7242.
Warning: The safety requirements included in the individual electrical test procedures shall be followed
- 3.3.2.2.8 Install G-10 wedge spacers into coil. Temporarily hold in place by applying a few drops of Acetone to uncured substrate.
- 3.3.2.2.9 Apply blue epoxy to coil filling in all voids between G-10 and conductor, and between conductors. Squeegee away any excess to eliminate high spots.
- 3.3.2.2.10 Butt wrap coil with .003" B-state epoxy impregnated fiberglass tape. Cut tape out directly over the midplane splices.
- 3.3.2.2.11 Double overlap wrap coil with .002" Teflon.
- 3.3.2.2.12 Install coil assembly into curing fixture using the

25-1779.03-03-4

.04-03-4

.05-03-4

curing segments. Cure @ 175°C for 90 min.

- 3.3.2.2.13 Remove coil assembly from curing fixture and remove Teflon tape.
Warning: Operators shall wear insulated gloves when handling heated coil
- 3.3.2.2.14 Take diameter measurements and record (data sheet).

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DESY-MAG-M-4000

Page 7 of 17

- 3.3.2.2.15 Install coil assembly into fiberglass wrapping machine.
- 3.3.2.2.16 Butt wrap entire coil with same material as in step 3.3.2.2.10.
- 3.3.2.2.17 In same machine wrap coil with epoxy impregnated S-glass fibre @ 27 lbs. tension and 18 turns per inch.
- 3.3.2.2.18 Double overlap wrap coil with .002" Teflon.
- 3.3.2.2.19 Install coil assembly into curing fixture using the same segments as in step 3.3.2.2.12. Cure @ 122⁰C for 90 min.
- 3.3.2.2.20 Remove coil from curing fixture and remove Teflon overwrap.
Warning: Operators shall wear insulated gloves when handling heated coil
- 3.3.2.2.21 Take diameter measurements and record (data sheet).
- 3.3.2.2.22 Perform Warm Measurements, RLQ, and Impulse Test. Perform Impulse & RLQ in accordance with RHIC-MAG-R-7227 /7228 /7318.
Warning: The safety requirements included in the individual electrical test procedures shall be followed
- 3.3.2.3 Third Layer Quadrupole
 - 3.3.2.3.1 Mount support tube into winding machine using mounting clamps and minimizing runouts. Clamp diameters may have to be shimmed to accommodate variations in tube diameters.
 - 3.3.2.3.2 Apply substrate to coil assembly.
 - 3.3.2.3.2.1 Using 12" wide material wrap substrate around the tube starting at the same axial position as the previous layers, four longitudinal seams may be used to get around pole leads of 1st and 2nd layer quad, but must be at the pole lead position.
 - 3.3.2.3.2.2 Using the 2" wide material, spiral wrap substrate between end pieces just installed (trim to fit).
 - 3.3.2.3.3 Measure and record diameter and runout measurements every 15⁰ around circumference at 5 axial positions. Record data in computer.
 - 3.3.2.3.4 Allowing a minimum of 6' coil (pole) leads, wind the 3rd layer quadrupole using the appropriate wiring file.
 - 3.3.2.3.5 Remove coil from wiring machine.

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DESY-MAG-M-4000

Page 8 of 17

- 3.3.2.3.6 Splice midplane leads together at locations shown on drawing by stripping back insulation and soldering together (side by side) with a minimum of 3" of overlap. Overwrap splices with two layers of .002" Kapton tape.
- 3.3.2.3.7 Perform warm measurements along with Hypot and RLQ checks. Perform Hypot & RLQ in accordance with RHIC-MAG-R-7227 /7228 /7242.
Warning: The safety requirements included in the individual electrical test procedures shall be followed
- 3.3.2.3.8 Install G-10 wedge spacers into coil. Temporarily hold in place by applying a few drops of Acetone to uncured substrate.
- 3.3.2.3.9 Apply blue epoxy to coil filling in all voids between G-10 and conductor, and between conductors. Squeegee away any excess to eliminate high spots.
- 3.3.2.3.10 Butt wrap coil with .003" B-stage epoxy impregnated fiberglass tape. Cut tape out directly over the midplane splices.
- 3.3.2.3.11 Double overlap wrap coil with .002" Teflon.
- 3.3.2.3.12 Install coil assembly into curing fixture using the
25-1779.03-04-4
.04-04-4
.05-04-4
curing segments. Cure @ 175⁰C for 90 min.
- 3.3.2.3.13 Remove coil assembly from curing fixture and remove Teflon tape.
Warning: Operators shall wear insulated gloves when handling heated coil
- 3.3.2.3.14 Take diameter measurements and record (data sheet).
- 3.3.2.3.15 Install coil assembly into fiberglass wrapping machine.
- 3.3.2.3.16 Butt wrap entire coil with same material as in step 3.3.2.3.10.
- 3.3.2.3.16.1 Wrap tube with .001" Kapton, no adhesive, with a 67% overlap.
- 3.3.2.3.17 In same machine, wrap coil with epoxy impregnated S-glass fibre @ 27 lbs. tension and 18 turns per inch.
- 3.3.2.3.18 Double overlap wrap coil with .002" Teflon.
- 3.3.2.3.19 Install coil assembly into curing fixture using the same segments as in step 3.3.2.3.12. Cure @ 122⁰C for 90 min.
- 3.3.2.3.20 Remove coil from curing fixture and remove Teflon overwrap.

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DESY-MAG-M-4000

Page 9 of 17

Warning: Operators shall wear insulated gloves when handling heated coil

- 3.3.2.3.21 Take diameter measurements and record (data sheet).
- 3.3.2.3.22 Perform RLQ measurements Impulse Test. Perform Impulse & RLQ in accordance with RHIC-MAG-R-7227 /7228 /7318.
Warning: The safety requirements included in the individual electrical test procedures shall be followed
- 3.3.3 Skew Dipole and Skew Quadrupole Layer.
 - 3.3.3.1 Mount support tube into winding machine using mounting clamps and minimizing runouts. Clamp diameters may have to be shimmed to accommodate variations in tube diameters.
 - 3.3.3.2 Apply substrate to coil assembly.
 - 3.3.3.2.1 Referring to the coil assembly drawing note the position of the skew dipole and skew quad windings. Using the 12" substrate material wrap substrate around tube in the locations of the ends of the coils (note that there are 4 coil ends on this layer) longitudinal seams must be at the pole locations of their respective coil.
 - 3.3.3.2.2 Using the 2" wide material spiral, wrap substrate between end pieces just installed (trim to fit).
 - 3.3.3.3 Measure and record diameter and runout measurements every 15° around circumference at 5 axial positions. Record data in computer.
 - 3.3.3.4 Allowing a minimum of 10' coil pole leads, wind the skew quadrupole coil using the appropriate wiring file.
 - 3.3.3.5 Allowing a minimum of 6' coil pole leads, wind the skew dipole coil using the appropriate wiring file.
 - 3.3.3.6 Remove coil from wiring machine.
 - 3.3.3.7 Splice midplane leads of both coils together at locations shown on drawing by stripping back insulation and soldering together (side by side) with a minimum of 3" of overlap. Overwrap splices with two layers of .001" Kapton tape.
 - 3.3.3.8 Perform Hypot and RLQ checks. Perform Hypot & RLQ in accordance with RHIC-MAG-R-7227 /7228 /7242.
Warning: The safety requirements included in the individual electrical test procedures shall be followed

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DESY-MAG-M-4000

Page 10 of 17

- 3.3.3.9 Install G-10 wedge spacers into coil. Temporarily hold in place by applying a few drops of Acetone to uncured substrate.
- 3.3.3.10 Splicing quadrupole coil leads.
 - 3.3.3.10.1 Refer to coil assembly drawing for correct splice configuration.
 - 3.3.3.10.2 Stabilize lead as close to coil as possible by soldering a second piece of conductor to the main conductor. The two conductors must be soldered in the proper configuration to fit into the slots of the G-10 spacers.
 - 3.3.3.10.3 Make the appropriate lead splices by soldering stabilized leads together with a minimum of 2" overlap.
 - 3.3.3.10.4 Repeat this process for 5 splices. Be sure to add voltage tap wires on quad interlayer splices, allow 48" of wire length.
- 3.3.3.11 Overwrap stabilized leads 67% overlap of .001" Kapton insulation.
- 3.3.3.12 Apply blue epoxy to coil filling in all voids between G-10 and conductor, and between conductors. Squeegee away any excess to avoid high spots.
- 3.3.3.13 Butt wrap coil assembly with .003" B-stage epoxy impregnated fiberglass tape. Cut tape out directly over the midplane splices and the quadrupole layer splices.
- 3.3.3.14 Double overlap wrap coil with .002" Teflon.

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DESY-MAG-M-4000

Page 11 of 17

- 3.3.3.15 Install coil into curing fixture using the
 25-1779.03-05-4
 .04-05-4
 .05-05-4
- curing segments. Cure @ 175⁰C for 90 min.
- 3.3.3.16 Remove coil from fixture and remove Teflon overwrap.
Warning: Operators shall wear insulated gloves when handling heated coil
- 3.3.3.17 Take diameter measurements and record (data sheet).
- 3.3.3.18 Install coil assembly into fiberglass wrapping machine.
- 3.3.3.19 Butt wrap entire length of coil assembly with same material as step 3.3.3.13.
- 3.3.3.20 Wrap coil with .001” Kapton, no adhesive, with a 67% overlap. Do not wrap over quad lead splices. Add G-10 tube covers over the quad lead splices.
- 3.3.3.21 In same machine, wrap coil assembly with epoxy impregnated S-glass fibre @ 27 lbs. tension, 18 turns per inch.
- 3.3.3.22 Double overlap wrap coil with .002” Teflon.
- 3.3.3.23 Install coil assembly in curing fixture using the same segments as in step 3.3.3.15. Cure @ 122⁰C for 90 min.
- 3.3.3.24 Remove coil from curing fixture and remove Teflon overwrap.
Warning: Operators shall wear insulated gloves when handling heated coil
- 3.3.3.25 Take diameter measurements and record (data sheet).
- 3.3.3.26 Perform RLQ measurements and Impulse Test. Perform Impulse & RLQ in accordance with RHIC-MAG-R-7227 /7228 /7318.
Warning: The safety requirements included in the individual electrical test procedures shall be followed
- 3.3.4 Corrector Coil Layer
- 3.3.4.1 Mount support tube into winding machine using mounting clamps and minimizing runouts. Clamp diameters may have to be shimmed to accommodate variations in tube diameters.
- 3.3.4.2 Apply substrate to coil assembly.

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DESY-MAG-M-4000

Page 12 of 17

- 3.3.4.2.1 Using the 12" wide substrate material, wrap substrate around coil assembly in locations of the coil ends (Note: there may be more than one correction coil). Longitudinal seams must be at the pole locations of their respective coils.
- 3.3.4.2.2 Using 2" wide material, spiral wrap substrate between end pieces just installed (trim to fit).
- 3.3.4.3 Measure and record diameter and runout measurements every 15° around circumference at 5 axial positions. Record data in computer
- 3.3.4.4 Allowing a minimum of 6' coil pole leads, wind the designated correction coil with the appropriate wiring file.
- 3.3.4.5 Remove coil from wiring machine.
- 3.3.4.6 Splice midplane leads of corrector coils together at locations shown on drawing by stripping back insulation and soldering together (side by side) with a minimum of 3" of overlap. Overwrap splices with 2 layers of .001" Kapton tape.
- 3.3.4.7 Install Nomex wedge spacers into coil. Temporarily hold in place by applying a few drops of Acetone to uncured substrate.
- 3.3.4.8 Double overlap wrap coil with .002" Teflon.
- 3.3.4.9 Install coil in curing fixture. Cure @ 175°C for 90 min.
- 3.3.4.9.1 Remove coil from curing fixture and remove Teflon overwrap.
Warning: Operators shall wear insulated gloves when handling heated coil
- 3.3.4.10 Splicing skew quadrupole coil leads.
- 3.3.4.10.1 Refer to coil assembly drawing for correct splice configuration.
- 3.3.4.10.2 Stabilize leads as close to coil as possible by soldering a second piece of conductor to the main conductor. The two conductors must be soldered in the proper configuration to fit into the slots of the G-10 spacers.
- 3.3.4.10.3 Make the appropriate lead splices by soldering stabilized leads together with a minimum of 3" overlap.
- 3.3.4.10.4 Overwrap stabilized leads 67% overlap of .001" Kapton insulation.
- 3.3.4.11 Butt wrap coil assembly with .003" B-stage epoxy impregnated fiberglass tape. Cut tape out directly over the midplane splices and the quadrupole layer splices.
- 3.3.4.12 In same machine, wrap coil assembly with epoxy impregnated S-glass fibre @ 27 lbs. tension, 18 turns per inch.

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DESY-MAG-M-4000

Page 13 of 17

- 3.3.4.13 Double overlap wrap coil with .002” Teflon.
- 3.3.4.14 Install coil in curing fixture. Cure @ 175⁰C for 90 min.
- 3.3.4.14.1 Remove coil from curing fixture and remove Teflon overwrap.
Warning: Operators shall wear insulated gloves when handling heated coil
- 3.3.4.15 Perform warm measurements along with Hypot and RLQ checks. Perform Hypot & RLQ in accordance with RHIC-MAG-R-7227 /7228 /7242.
Warning: The safety requirements included in the individual electrical test procedures shall be followed

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DESY-MAG-M-4000

Page 14 of 17

4 Quality Assurance Provisions:

4.1 The Quality Assurance provisions of this procedure require that the technician shall be responsible for performing all assembly operations in compliance with the procedural instructions contained herein and the recording of the results on the production traveler.

4.2 The technician is responsible for notifying the technical supervisor and/or the cognizant engineer of any discrepancies occurring during the performance of this procedure. All discrepancies shall be identified and reported in accordance with RHIC- MAG-Q-1004.

4.3 Measuring and test equipment used for this procedure shall contain a valid calibration label in accordance with RHIC-MAG-Q-1000.

5 Preparation for Delivery:

5.1 N/A

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DESY-MAG-M-4000

Page 15 of 17

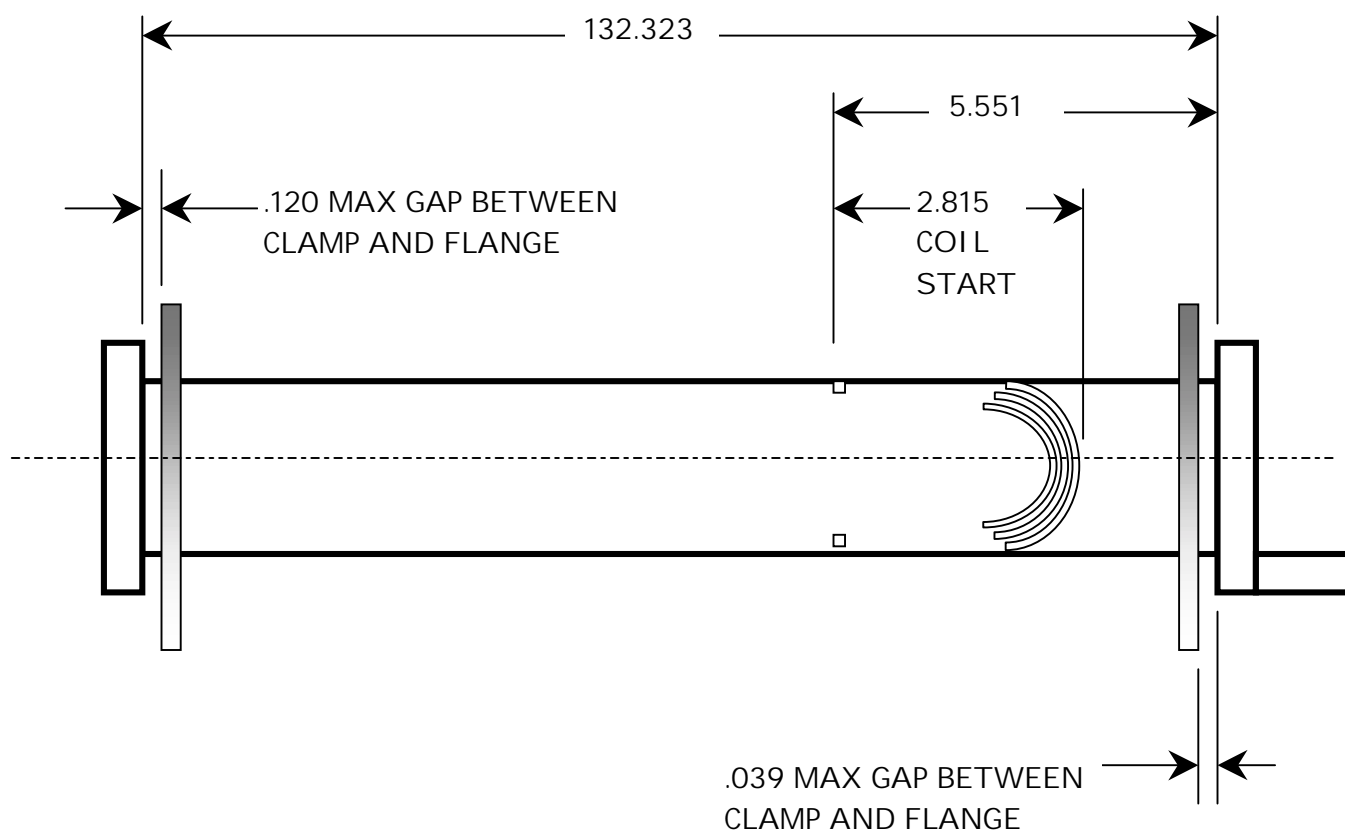


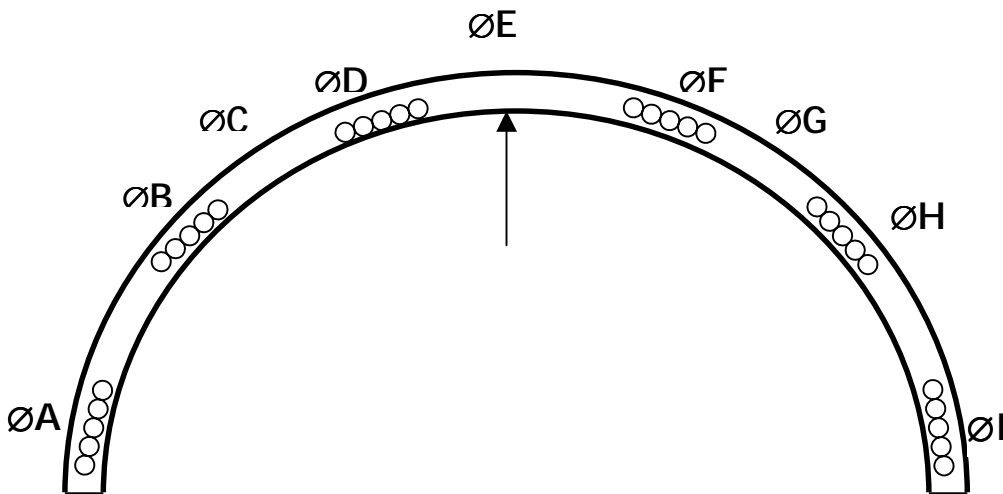
Figure 1
Clamping Locations

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DESY-MAG-M-4000

Page 16 of 17

DIPOLE – SAMPLE DATA SHEET
END VIEW (LEAD END) / POSITION #1 - #6



<u>DIAMETER MEASUREMENTS EVERY 24"</u>						
	<u>POSITION</u>					
	#1	#2	#3	#4	#5	#6
<u>A</u>						
B						
C						
D						
E						
F						
G						
H						
I						

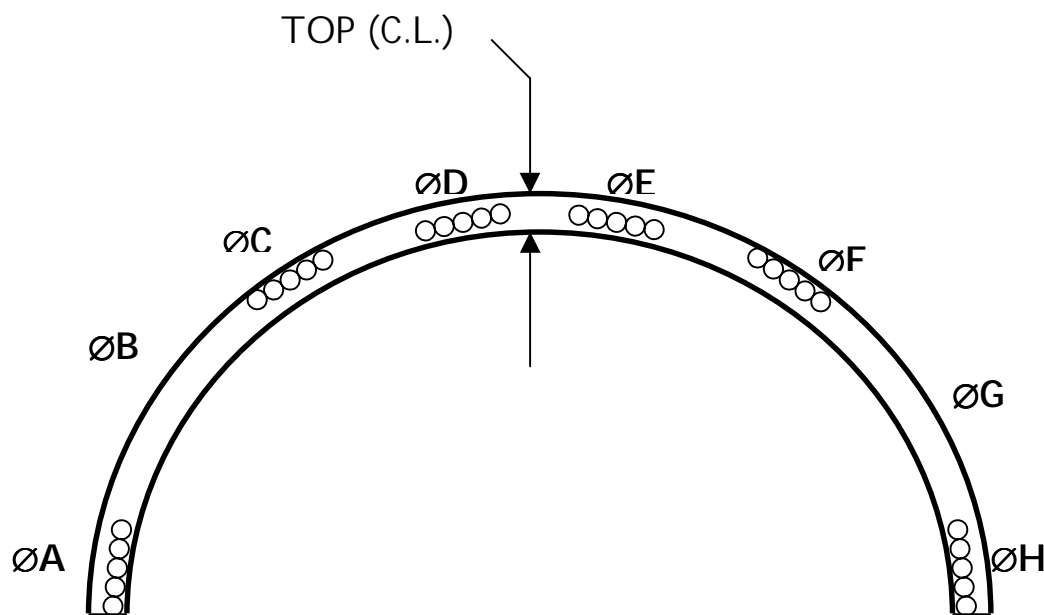
Figure 2
Sample Dipole Data Sheet

The only official copy of this file is the one on-line on the Superconducting Magnet Division website. Before using a printed copy, verify that it is the most current version by checking the document issue date on the website.

DESY-MAG-M-4000

Page 17 of 17

QUADRUPOLE – SAMPLE DATA SHEET
END VIEW (LEAD END) /POSITION #1 - #6



<u>DIAMETER MEASUREMENTS EVERY 24"</u>						
	<u>POSITION</u>					
	#1	#2	#3	#4	#5	#6
<u>A</u>						
B						
C						
D						
E						
F						
G						
H						

Figure 3
Sample Quadrupole Data Sheet